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solplan review

the independent newsletter of energy conservation, building science & construction practice

Inside . . . .

Changes in building practices and homeowner expectations mean that we are building tighter houses. As a result, there is strong pressure to ensure that homes have adequate ventilation. A CSA standard is being finished, and is likely to be in the building code by 1995. But what are the cost implications? We review some work that has been done recently assessing the cost implications.

Caulks and sealants are increasingly being used to ensure a tight draft free building envelope. We present a chart of key features of these products.

Some time ago we reported on a fireplace damper for seldom used fireplaces. We present an update.

Vinyl flooring is used regularly. Depending on location and type of subfloor, there could be problems. We comment on a specific problem and on efforts to determine the extent of the problem.

Other items include a report by Mario Kani on the EEBA conference in Colorado, an update on direct vent gas fireplace certification, results of airflow distribution studies, CHBA - TRC news, and more.

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Ventilation: Cost Implications

From the publisher

Research is the key to new product development, refinement of existing processes, and finding how to correct old problems. To the non researcher, the work may seem obscure, like the mumbling of medieval philosophers trying to calculate how many angels can dance on the head of a pin. In reality, it's not all obscure, and has very practical results.

A strong independent organization to research issues of concern to the building sector is needed. But who is going to pay for the work? Budget restraints and cutbacks in the public sector are placing greater demand on industry to finance research that formerly was funded by the government.

The National Research Council has been the lead agency for building research in Canada. Recent cutbacks in government funding to research activity should be of concern to everyone in the construction industry. The cuts in basic building research activity shows the total insensitivity of the government to the industry.

Why does the government have to be involved? Private corporate research is too often very shortsighted, oriented to the short term bottom line rather than dealing with fundamental issues. The building industry has many small players. The contractor who puts together many products into a new system does not have proprietary rights to the end product, and has the least resources to undertake research how all these products relate with each other.

There is little information transfer in private R&D. Why should XYZ Company let their competitors in on research work they have financed? Who is going to do research work on basic issues that are at best indirectly related to a specific product?

The cutbacks at NRC mean that they have to leverage their funds to get the most out of their budget, so that research is done if it is in the interests of a given company that is able or willing to contribute funding. This has led to pressures to search for funds from new sources. We have heard that overtures are being made in Japan and Korea.

If the rumours are true, it would mean that we may end up subsidizing foreign companies to develop products that will find their way back into Canada. A branch plant manager may see little wrong with this state of affairs, but it's not the way to run a country!.

It is not too late to communicate with your MP and let them know about the importance of R & D to the housing industry.

R Kadulski

Richard Kadulski
Publisher

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Mechanical Ventilation: What is the cost of CSA F326.1?

Richard Kadulski

Changes in construction practices and today's desire for more comfortable housing means tighter draft free construction is increasingly the norm. In the tighter house there is not enough air change to ensure adequate fresh air to maintain good indoor air quality, to remove odours and control moisture levels in the house. Even in leaky older houses there is no certainty of adequate fresh air when it is needed.

Why Ventilate?

In the last 40 years construction practices has changed significantly due to the use of new sheet materials and greater emphasis on insulation, caulking and sealing so that special attention must be paid to ventilation. This has now been recognized in the building code and is the subject of a new draft CSA standard for residential ventilation. The changes will have a major impact on the building industry and local building authorities.

The object of ventilation is to maintain indoor air quality for health and comfort, and to control moisture levels in the house to preserve the building and its contents.

Until recently residential ventilation was achieved accidentally through random leakage across the building envelope, the exhaust action of open chimneys (fireplaces and naturally aspirating appliances) and fans. Odours, stale air, and moisture generated indoors were generally removed by combustion appliances and other exhaust routes. However, the major concern is to maintain temperature, humidity and air movement conditions for comfort. Traditionally during the heating season in Canada we have closed up our homes as tightly as we could, and applied heat to maintain comfort levels. Opening a window in winter has never been a comfortable option.

Indoor Pollutants

Ventilation controls the build up of indoor pollutants generated by occupants. Major contaminants of concern are water vapour, carbon dioxide, odours, combustion gasses such as carbon monoxide and nitrogen oxides, radon gas, particles (including airborne fungi, bacteria, viruses and volatile organic compounds such as formaldehyde).

The sources of these are normal metabolic processes, cooking and bathing, combustion, soil gasses, offgassing of building materials and contents, plus activities such as hobbies and smoking. Pollutants generated by building products and soil gasses should be dealt by proper attention to building materials (by using clean products) and construction details. Only pollutants generated by normal household activities are the ones that are dealt by ventilation.

Passive ventilation (which is what has traditionally be relied upon) is driven by temperature differences and wind. It is controlled by opening windows and other vents and uncontrolled passive ventilation by air leakage through random cracks, but it is weather dependent, so there is too much during cold weather and windy conditions. During warm calm weather (as in spring and fall) there is not enough ventilation.

Moisture control is better dealt with by proper exhaust systems, while the problem of hidden condensation is reduced by air sealing measures.

Combustion gases are another area of concern in new housing. Standard fuel burning appliances, when used at the same time as large exhaust fans and traditional fireplaces, can back-vent so that flue gasses spill inside. Accidental passive ventilation is no longer enough to ensure comfort and indoor air quality.

Mechanical Ventilation

Controlled ventilation which ensures adequate air change for health, comfort and humidity control is a must which follows naturally from the changes that have been happening in the housing industry.

How is ventilation measured?

Air Changes per hour (ACH)
The number of times per hour that the entire volume of air is exchanged with outside air as a ratio of total building volume. *An air change rate of 0.5 ACH means that half the air of the house is exchanged each hour (or the total volume is changed every 2 hours).*

There is little distinction between large or small houses, or between heavily or little occupied rooms. Ventilation calculated by ACH can provide inadequate ventilation for a small house, but too much for a large house.

Ventilation flow rate:
litres per second (l/s) or cubic feet per minute (cfm).

A flow rate specified either by number of occupants or number/type of rooms more closely matches ventilation to the actual needs. This is the approach used in commercial and institutional buildings.

The need for fan operated ventilation systems is now recognized, but the standards, hardware and common expertise required to achieve this in all construction are not entirely in place.

Mechanical ventilation has been a central feature of energy efficient houses built in Canada for the last decade, and a key feature in the R-2000 Program. The experience gained from extensive monitoring activity has had considerable influence on the CSA Standard. The requirements are not arbitrary or without justification. However, concerns have been raised about what impact these ventilation standards may have on house construction when it is introduced into the mainstream for all housing.

As with changes to any regulations, industry needs to know what the impact is going to be. With the encouragement of the Technical Research Committee of CHBA, CMHC has undertaken an impact study of mechanical ventilation: to evaluate the impact on installed costs, air change rates and energy consumption.

How much ventilation is needed?

There is no magic number that tells us how much ventilation air is needed. The general consensus is that for a non smoking person about 15 - 20 cubic feet per minute provides adequate fresh air.

The B.C. Building Code calls for a system capacity of 0.5 Air Changes per hour. If the ventilation system distributes air, the system capacity must not be less than 0.3 ACH.

CSA F326.1

CSA has developed a draft standard for Residential Mechanical Ventilation. (CSA F326.1) This standard is being refined and is expected to be issued as a regular standard within the year. (It is expected that it will be referenced in the next edition of the National Building Code of Canada).

The standard calls for a ventilation system capable of operating continuously, distributing fresh air to each room (air just brought into the basement or a utility room will not necessarily get to the living areas where it is most need by residents). The quantity of air flow is calculated based on the estimated occupancy (at 10 cfm per room, 20 cfm to master bedroom). Air must be exhausted from bathrooms and kitchen (the principal areas generating pollutants). Equipment must operate quietly and must not create pressure imbalances on the house

Houses with open combustion appliances cannot be depressurized to more than 5 pascals (excessive depressurization will backdraft fireplaces, or other combustion appliances). If the combustion appliances are sealed or induced draft (i.e. they will not backdraft) then the depressurization limit is 10 pascals. In all cases, the maximum depressurization allowable is 10 pascals. To limit negative pressures, appropriate make-up air provisions must be provided.

What happens when the standard becomes mandatory?

Before one can asses the impact of ventilation systems meeting the draft CSA requirements we need to know what ventilation systems are used now? What types of systems are available now? How much does the mechanical ventilation cost, to install and to operate? What are the benefits of improved health and safety of homes with better indoor air quality?

Heating systems

Heating systems are important as the ventilation system can be integrated directly into forced air heating systems so that the heating ducts are used to distribute the incoming fresh air. For fuel fired appliances, unless the combustion is isolated from the house, it is important to avoid pressure imbalances to reduce the chances of flue gas reversal.

Electricity and natural gas are the fuel sources for about 90% of all heating systems in Canada. About 58% of all systems use a forced air type of system (in Quebec and Atlantic Canada where gas is not widely available, only 1 out of 5 uses forced air heating).

Fireplaces, which can backdraft flue gases into the house, are installed in about 38% of new houses (1 in 2 houses in BC, Alberta, and Ontario have them, but only 2 out of 10 in the other regions).

Current Ventilation Equipment

Over 80% of new houses have exhaust fans and kitchen range hoods, 95% have clothes dryers, 29% have central vacuums and about 10% have heat recovery ventilators. If all the intermittent exhaust fans are running at the same time, 29% of new houses could experience exhaust rates of 450 cfm, 80% of houses 350 cfm, or more.

As our report on airtightness of new homes (SOLPLAN REVIEW No. 32) indicated, many houses would experience a negative pressure of 5 pascals or more at these flows. (5 pascals negative pressure is considered the maximum allowable depressurization if there are open fuel burning appliances in the house).

Ventilation systems

There are many ways to design a ventilation system. Each will vary from region to region depending on house size and layout, availability of qualified trades, equipment, types of heating systems used, as well as climatic conditions and local building practices.

In order to assess the impact and relative units of various ventilation alternatives, certain assumptions have to be made to generate a reasonable base for useful comparisons. The CMHC study looked at a 958 sq.ft. bungalow with basement, and a 3100 sq.ft. two storey house with basement.

Four ventilation system designs for forced air heating, and four designs for non-forced air heating were prepared. Cost information was obtained by preparing detailed working drawings and specs and having a number of mechanical contractors in various parts of Canada quote on them. Additional cost information (for components and labour) were also obtained.

Capital costs can be established for the incremental costs of equipment associated with each of these systems.

Ventilation systems used with non-recirculation heating (e.g. electric or hydronic baseboards) have incremental costs that are about $1000 higher due to the additional ductwork required to supply room-by-room fresh air.

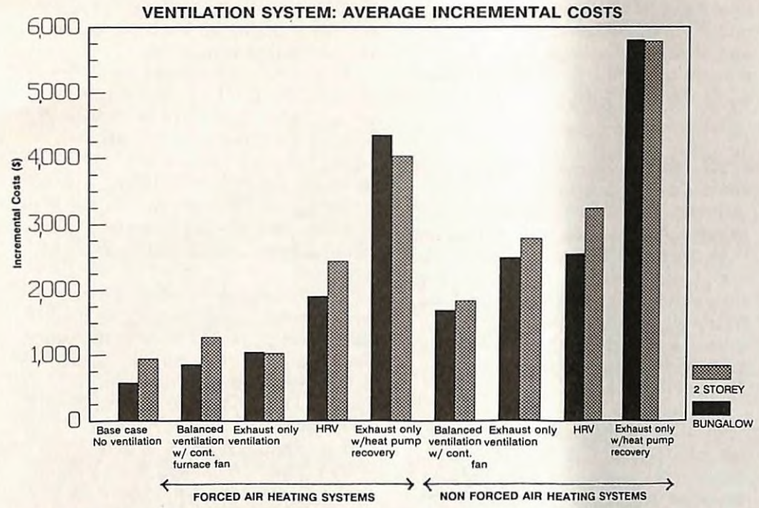


Figure 1

Fig. 1 shows the comparative incremental costs of the systems modelled. The base case ('no ventilation') is the standard fans that are installed now. In the designed ventilation system these are either upgraded or replaced with alternative equipment.

For purposes of modelling, two envelope tightness levels were assumed. One was a "loose" house (with an average natural air leakage of 0.35 ACH). This corresponds to an equivalent leakage area of 74 sq. inches for the bungalow, and 167 sq. inches for the two storey house.

The second was a "tight" house, based on airtightness levels of many houses presently being built. The equivalent leakage areas of the building envelope was assumed to be 16.25 sq. inches for the bungalow, and 27 sq. inches for the two storey house.

Assumed insulation levels and operating traits were for a house built in Ottawa to building code requirements. Ventilation systems were designed to meet the intent of the CSA standard.

Air leakage modelling for two example houses was done by computer simulation to determine the relative proportion of ventilation supplied by air change through the building envelope, by mechanical ventilation, and an undampered make-up air duct. Fig. 2 shows the proportion on each for a 'loose' and a 'tight' house, for the bungalow and 2 storey house.

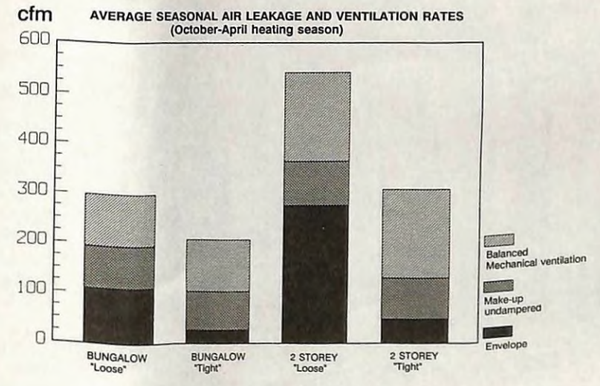


Figure 2

Ventilation system designs:

Forced Air heated houses
(i.e. with recirculation)

1. Balanced ventilation with a central exhaust fan, ducted from kitchen and bathrooms; supply air is mechanically induced by hard ducting to the return air plenum. No heat recovery.
2. Central exhaust only, ducted from kitchen and bathroom. Supply air is passively introduced to the return plenum. No heat recovery.
3. Heat recovery ventilator (70% efficient HRV) with supply ducted to return plenum.
4. Central exhaust only, ducted from kitchen and bathroom, but heat is recovered from the outgoing air, to heat domestic hot water.

Non Forced air heated houses
(i.e. baseboard or radiant)

5. Balanced ventilation with central exhaust fan ducted from kitchen and bathroom, supply air mechanically introduced, ducted to bedrooms and living areas. No heat recovery.
6. Central exhaust only, ducted from bedrooms and living areas. Second exhaust system for kitchen and bathrooms. Supply air is assumed to be brought in by engineered inlet slots through the wall, windows, etc. No heat recovery.

7. Heat recovery ventilator (70%) fully ducted supply to bedrooms and living areas, exhaust from kitchen and bathrooms.

8. Central exhaust only, ducted from bedrooms and living areas. Second exhaust system for kitchen and bathrooms. Supply air is assumed to be brought in by engineered inlet slots through the wall, windows, etc. Heat is recovered from the exhaust stream to preheat domestic hot water.

The Simulations

If one relies only on natural envelope infiltration and accepts that the minimum air change rate for health reasons is 0.35 ACH, then during most of the heating season many loosely built houses will experience higher than necessary air change rates due to stack and wind effects. Cold, windy climates can easily experience average air change rates 50% higher that the minimum required and the peak infiltration could be double.

If the F326 ventilation provisions were combined with good airtightness practices (i.e. tight house construction with dampered vents and the ventilation system operated continuously), the minimum ventilation rate for the two-storey would be just over 0.3 ACH with a seasonal average of 0.36 ACH. However, depending on uncontrolled air leakage alone does not ensure that there will be adequate air quality in all parts of the house.

Costs

The incremental cost of ventilation systems can be determined easily. A second cost must be considered: the energy cost associated with ventilation.

Figure 3 shows the capital costs plus energy costs over a 10 year period for a variety of ventilation systems with forced air and non-forced air heating systems compared to the base case, for loose and tight envelopes (calculated for the Ottawa example).

By adding a continuous ventilation system with a relief hole (for make-up air) to a house with the base case air leakage (i.e. a house that already has fresh air entering at a rate approximately equal to the F326 provisions), the total energy consumption can easily increase by 50%. However, by air sealing, adding heat recovery and a damper on the make-up air vent, the annual heating energy consumption is less than the base cases.

The F326 standard allows large flexibility in designing and installing ventilation systems while at the same time minimizing backdrafting potential of combustion equipment.

Assuming conventional ventilation practice the two base case houses have annual space heating costs of $950 and $1900 for conventional gas heating equipment and $1200 and $2450 for electrical heating. Ventilation systems and make-up air vents meeting F326 in the base case (loose) houses without heat recovery can increase these costs by 80%.

In tight houses systems with heat recovery can mean savings up to $250 in the bungalow and $800 in the two-storey house. If the relief holes are fitted with controlled dampers, a further $140 - $170 for gas and $250 - $300 for electricity can be saved.

The combined effect of heat recovery ventilators and dampering of make-up air vents can account for a 4 to 6 kW reduction in space heating capacity.

"Potential Impacts of the Proposed CSA Standard F326: Residential Mechancial Ventilation Requirements", a study prepared for CMHC, 1990 by Allen Associates, Toronto. This was also a paper presented by Mario Kani at the EEBA conference, Denver, Colorado April 1990.

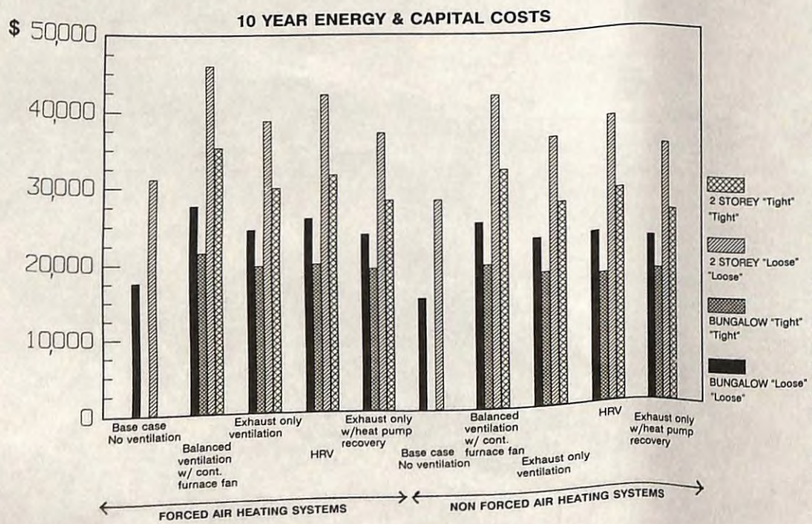


Figure 3

Plywood Subflooring

A new smooth specialty plywood designed as a sub floor for resilient flooring is being manufactured by Fletcher Challenge (ULAY), MacMillan Bloedel (SYLVAFLOR) and Richmond Plywood (RICHFLOR).

The material offers a smooth, stable, strong surface for all seamless floor coverings and is sanded to fine tolerances. The plywood, (performance-guaranteed) features a puncture-proof solid core layup and a sanded, solid wood face with no synthetic patches.

They are available in 8.5 mm or 9.5 mm thickness, and made in both Douglas fir plywood (DFP) and Canadian Softwood plywood. (CSP)

Book Review: Permanent Wood Foundations

Pressure treated lumber for wood foundations has been used for over 30 years, with more than 200,000 having been built to date. Built as a system, with care taken to ensure proper drainage, the basement areas remain dry and are easy to insulate, to give a warm and comfortable living space.

In many cold climate areas they are easier to build in winter than concrete; in some they are the only way to build during the winter. In areas far from concrete mixing plants, they are much more economical.

For anyone not familiar with PWF construction, but thinking about using this type of construction, there is a new handbook that will be of tremendous help: a new edition of **Permanent Wood Foundations**.

It is a good supplement to all the technical publications the lumber industry has prepared which cover the construction and design of PW foundations. It is an illustrated, practical applications manual that is more than just a dry reference to the technical standards and requirements for wood foundation construction. It is clearly written with handy construction tips throughout the book.

The book includes: a discussion of design and material issues including fasteners and connectors, sealants and adhesives, Standards governing PWF, soils, excavation, drainage system, footing systems & design, services, foundation wall design and construction (design for racking, floor structure systems, basement floor systems, kneewalls, insulation, exterior finishes).

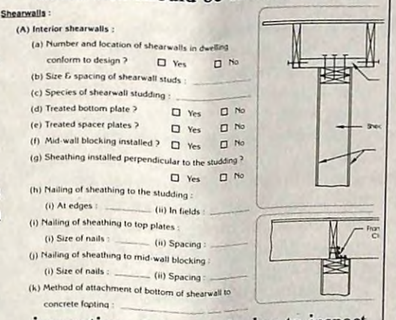
Sections are colour coded, with tabs on the edge of the page, which makes it easy to find a section dealing with a specific topic.

The author ventures a bit further than just talking about foundations, relating the structure to the rest of the house. It is here that a few errors have cropped in: the author suggests that clothes dryers could be vented through the heat recovery ventilator (this is definitely not desirable. There is too much lint in the dryer exhaust that will plug up the HRV quickly).

The second major flaw is when the author talks about moisture in the house. He does not point out that a properly designed ventilation system in the house will control indoor humidity levels.

If one ignores these points it is an otherwise well organized and presented book. Anyone who uses PWF should look at the book.

A companion document is the **Permanent Wood Foundation Inspection Report** This is an illustrated 24 page booklet that presents a step by step checklist of items that should be checked in a site


Shearwalls :
(A) Interior shearwalls :
(a) Number and location of shearwalls in dwelling conform to design ? ☐ Yes ☐ No
(b) Size & spacing of shearwall studs :
(c) Species of shearwall studding :
(d) Treated bottom plate ? ☐ Yes ☐ No
(e) Treated spacer plates ? ☐ Yes ☐ No
(f) Mid-wall blocking installed ? ☐ Yes ☐ No
(g) Sheathing installed perpendicular to the studding ? ☐ Yes ☐ No
(h) Nailing of sheathing to the studding :
(i) At edges : (ii) In fields :
(i) Nailing of sheathing to top plates :
(i) Size of nails : (ii) Spacing :
(j) Nailing of sheathing to mid-wall blocking :
(i) Size of nails : (ii) Spacing :
(k) Method of attachment of bottom of shearwall to concrete footing :

inspection. Anyone who has to inspect PWFs will find this useful, as most entries are simple fill in the blanks or check off yes/no answers.

Builders will find it a useful checklist that can become a permanent project record. If any problems crop up, you would have a complete documentation of the job (which should reduce any arguments about what was done).

Permanent Wood Foundations by Gary J. Gibson; $35.00
Permanent Wood Foundation Inspection Report $1.95
Sure-West Publishing Inc. Box 5019 Red Deer, AB T4N 6A1

Finding and fixing hidden air leaks in houses.

Caulking and weatherstripping is one of the most common recommendations for reducing air infiltration to improve the comfort and energy efficiency of a home, yet research tells us that we often don't get the savings we expect from this effort. Detailed research into air movement in homes during the past few years shows that a substantial amount of air leakage occurs through hidden passageways in the interior walls of homes. Traditional caulking and weatherstripping recommendations pay attention only to exterior walls, so these hidden air leaks will never be sealed.

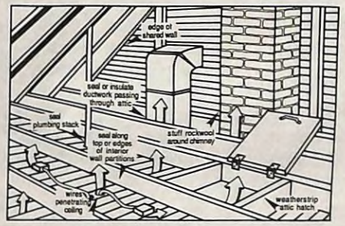


Figure 3. Important places to stop air leaks into attics.

To provide consumers and weatherization contractors with up to date information about effective air sealing of homes the Oregon State University Extension service has prepared **Finding and Fixing Hidden Air Leaks**. The eight page publication provides practical non-technical information which will be of use to anyone wanting to effectively reduce air leakages in typical single family homes.

"Finding and Fixing Hidden Air Leaks" *single copies are available at no cost from Publication Orders, Agricultural Communications, Oregon State University, (Administration Services Bldg. 422) Corvallis, Oregon 97331.*

New Product update: Fireplace Dampers

In SOLPLAN REVIEW No. 24 we reported on a study that measured the leakiness of typical fireplace dampers. After use, the typical damper deforms and even when closed is very leaky.

The study was done to provide an independent evaluation of the effectiveness of a new approach to sealing fireplaces.

Why seal fireplaces?

Mainly it's to reduce heating and cooling costs as well as to eliminate uncomfortable drafts in the immediate area of the fireplace.

Many houses have at least one fireplace, but often they may only be used 2 or 3 times per year. The rest of the time the fire place is cold and frequently a source of drafts.

Those cold rec rooms with the decorative fireplace are the type we are talking about. In recent years fireplace doors have become more common. Glass doors retrofit on masonry fireplaces help, but never are very tight. Occasionally people make up a plywood or insulated panel to fit over the opening.

Is there another approach?

The **DAVIC Heatsaver:** is a patented device that can best be described as an inflatable pillow that fits into the damper area. It is installed deflated, and inflated by blowing into the unit through a plastic tube that is part of the unit. Once inflated, a plastic lock device seals the inflated unit.

The Heat barrier installed

It is made of a tough, transparent polyurethane plastic, and it allows for a good fit against a selection of damper shapes and sizes. It seems to fit into any type of standard fireplace throat. Except for the inflating tube, once in place it is not visible.

Inflating the heatbarrier is simple

The fireplace has to be cleaned before it is installed and it may be a bit dusty when you take it out, so it would be of limited interest to the regular fireplace user. But if the fireplace is not used often, it will be worth the effort.

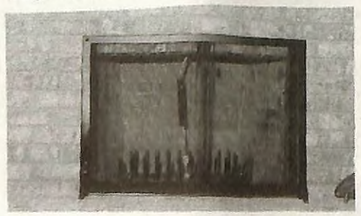
Residents in houses where prototype units have been installed note the increased comfort. Rooms that were not useable before because of the cold drafts have been reclaimed.

Energy savings will vary with climate, average wind speeds and price of energy. Savings are estimated to range from $16 to $90 for the majority of houses in Canada and the Northern USA.

Marketing arrangements are being finalized. The manufacturer expects they will be handled in most hardware outlets. The cost? $36.00.

Until regular marketing channels are established, a limited number will be available from Solplan Review for $36.00 (plus $2.50 for postage & handling).

Commercial/distributor enquiries will be forwarded to the manufacturer.



The Heatbarrier installed: only the transparent tube is visible

Sealants

Sealants and caulks have been used for a long time. In recent years, caulks have taken a greater prominence as we have stressed the need to draft seal construction. The impact of these products on the performance of the house is far greater that their cost. For an average house, the total cost of caulks and sealants may be $200 - 400. Yet too often, the wrong products are used.

A variety of products are available. The choice depends on ease of application in the field, clean up (how easy it is to clean up is important too!), whether the caulking is exposed or covered, and how much movement is likely to happen.

The chemical properties of the materials being caulked must be considered to ensure compatibility (you don't want the caulking to eat away the protective coating of an electric wire or to dissolve the block of foam insulation).

Caulks must be durable, should not dry, shrink or crack. Application must be in accordance with manufacturers recommendations for the product. A good product used incorrectly will not be worth the effort.

The accompanying chart lists some of the properties of a range of typical sealants used in residential construction. For specific product information, refer to manufacturer's spec sheets.

CAULKS AND SEALANTS

	BUTYL RUBBER	ACRYLIC LATEX	ONE PART URETHANE	ACOUSTICAL SEALANT	SILICONE	URETHANE FOAM
Colours	wide range	wide range	wide range	black, brown, grey	black, white, grey & clear	white/tan; yellows on exposure
Price	low ($2.60)	low ($2.25)	high ($4.50)	low ($3.50)	low-high ($3.50 - 6.00)	high cost
Toxicity		non toxic	potentially toxic	non toxic	non toxic	potentially toxic
Odour while curing	aromatic	latex paint smell		aromatic	strong vinegary odour	
Service life	4-10 years (exterior use)	10 years (exterior use)	20-30 years	20+ years	20+ years	10-20 years
Service Temperature range	-28°C to 93°C	-28°C to 65°C	-40°C to 121°C	-40°C to 82°C	-54°C to 175°C	-40°C to 121°C
Resistance to:						
water immersion	fair to good	poor	good to excellent	fair	poor	fair
abrasion	fair	poor	good	poor	fair	poor
fire	fair	fair	poor	fair	good	poor to fair
Adhesion to:						
dry surfaces	fair to good	good to fair	good to excellent	excellent	good to excellent	good
wet surfaces	poor	good to fair	poor	poor	poor	poor to fair
Max joint size	12mm wide (½")	9mm wide (3/8")	19mm wide (3/4")	16mm wide (5/8")	25mm wide (1")	suitable for large gaps
Max movement	±5% to ±10%	±2%	±25%	±10%	±12% to ±50%	±1%
Application Temperature	+4.4°C to 50°C	above 4.4°C	above 4.4°C	above -15°C	-29°C to 38°C	above 2°C
Drying time						
- to touch	2-72 hours	½ - 1 hour		52 hours	10 minutes to 1 hr	1 hr or less
- to cure	120 days	14-30 days	14-30 days		24 hrs to 14 days	1 day or less
Shrinkage	10% - 35%	5% to 10%	no shrinkage	variable shrinkage	nil to 3%	none (expands on application)
Handling precautions	ventilate during curing to remove flammable vapours, avoid skin contact	no special precautions	ventilate to remove potentially toxic vapours, avoid skin contact	ventilate during curing to remove flammable vapours	ventilate during curing, uncured sealant irritates eyes, avoid skin contact	ventilate to remove potentially toxic vapours, avoid skin contact
Uses	caulk & seal where limited movement, e.g. wood sash & interior doors & windows	general purpose good on non-porous surfaces (metal, glass, ceramic); strength reduced if used on wet wood.	Joints with movement; bonds metal, glass, concrete, wood & masonry; weather resistant	Non-hardening, non skinning, bonds to polyethylene; Hardens when exposed	Watertight flexible seal, adheres to most building materials but requires clean surfaces.	Used for sealing hard to get at locations with little movement.
Limitations	Little UV resistance, must cure at least 1 week before painting	Not good in permanently damp environments, subject to mildew	Surface preparation needed; not for contact with polystyrene, asphalt or tar compounds	Sticky & stringy during use, clean up difficult; bonding to porous wood surfaces will result in drying; can't be painted if exposed	Most can't be painted, some surfaces require special preparation	Not for moving joints; needs heating if below 21°C before use; does not adhere to poly, teflon or silicone; difficult to clean when cured. High flame rating.

South of the Border: 1990 EEBA Conference

by Mario Kani

The Annual conference of the Energy Efficient Building Association (EEBA) is one of the key meetings that brings together builders and researchers at the leading edge of energy efficient building practice.

This year the conference was held in Denver, Colorado in early April. Compared to last year's meeting in Winnipeg this year there were few Canadians. Conspicuous by their absence were representatives of the Canadian Government. (I met no one from EMR or NRC).

Energy and the Environment

Today's environmental concerns are arising out of fears about real events in the world. As public concern increases, there is going to be an ever greater pressure to change the way we do business, and it is going to affect everyone. The building industry will see higher costs, new regulations, new products, and banning of products currently on the market.

While some media stories recently have tried to deny that global warming is real, John Frisor of the U S National Centre for Atmospheric Research pointed out that greenhouse gas build-up in the atmosphere is still climbing rapidly. This will have severe climatic consequences in the future. The USA is still the largest producer of CO_2 gas (1,200 million tonnes; The USSR produces 800 million tonnes; Latin America 250; Japan 225).

Several us politicians are sponsoring a bill in the U.S. Congress to control the emission of greenhouse gasses. A bill expected to be tabled within the next 2 months by Colorado Senator Wirth will call for a freeze of greenhouse gas emissions immediately, with a 20% reduction in 15 years; that the Department of energy appoint a Director of Climate and the promotion of energy efficiency in all sectors with a reduction of energy consumption of 4% by 2005.

Other similar proposals are in the works. While many may be window dressing, there is a strong public feeling that something must be done U.S. politicians are taking things a lot more seriously that our own government!

The GUPPIE: A New Market Opportunity

Jim Leach, a prominent Colorado home builder notes that public awareness of environmental issues has been raised by accidents such as the EXXON Valdez oil spill and talk of global warming. This has increased the interest in energy efficiency, but the main motivation for many is saving the environment, not saving energy dollars. He suggested that the concept of "paying 5-10% more to save the planet" is marketable. This is creating a new green yuppie (or GUPPIE) market.

Builder members of EEBA seemed to miss the opportunity to take advantage of this new marketing strategy and show social responsibility at the same time. At the general meeting, a discussion on marketing of energy efficient houses ignored the environmental arguments. Instead of upgrading their product to satisfy the public environmental interest, a suggestion was made to investigate why log homes sales have increased.

Buildings and CFC's

Alternatives to ozone depleting chloro fluorocarbons (CFC's) were discussed in two papers.

Robert Foster from New Mexico State University discussed the opportunities for evaporative cooling. The air conditioning industry is facing severe restrictions on the use of conventional CFC's. 33% of total CFC use in the USA is for refrigerants in air conditioning and refrigeration. As a result, they are scrambling to find alternative chemicals. Fully halogenated CFC's (or HCFC's) are a prime candidate. The new HCFC's will be more expensive than currently used CFC's, and their cooling capacity is lower.

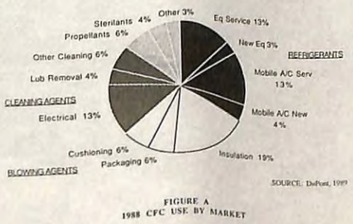


FIGURE A
1988 CFC USE BY MARKET

Other alternatives: non-CFC cooling

Primarily used in dry climates, evaporative cooling systems are a low cost, non-CFC solution. Also known as "swamp coolers", these pass dry hot air over a wetted mat. Sensible heat is used to evaporate some of the water, lowering the sensible (dry-bulb) temperature of the airstream while almost saturating it with moisture. The air stream is then mixed with the relatively drier building air to achieve comfortable conditions. This method of cooling could be retrofitted to existing cooling equipment to make up the deficit in performance when it is recharged with the new HCFC's.

Large amounts of CFC's (especially CFC-12) are used to produce rigid foam insulations. A paper by John Minsker reported on DOW Chemical's efforts to replace CFC blowing agents with alternatives. They shrewdly play one environmental concern against another.

"*Continued use of [plastic foam insulation with CFC's] will be important to minimize global warming through energy efficient design and construction .... If CFC's were no longer available and no alternative compounds could be identified, the loss of insulating efficiency could lead to greater energy consumption and other costs to the consumer, the economy and the environment.*"

The argument sidesteps presently available competitive, but more benign insulation products.

Political developments regarding the control of CFC use are interesting and also disturbing. The US has accepted the Montreal protocol which calls for a freeze on CFC use as of July 1989. The U.S. Congress imposed (effective January 1, 1990) a tax of $1.37 per pound of CFC which more than doubles the price. However, insulation foam manufacturers are exempt until 1991, after which they will be charged only $0.25 per pound, the rationale being that energy efficiency would suffer.

The removal of ozone destructive chemical is moving forward, quickly. Conversion to an alternative, less damaging gas (HCFC-142b) is two thirds complete in North America and completion of conversion in Europe and Japan is slated for the end of 1991, a year after North America.

Low-Tox Construction

Paul Bierman-Lytle, an architect with Masters Corporation in Connecticut presented a number of projects for "clean" custom homes for chemically sensitive persons. (Most of their projects are for clients in higher income brackets). Materials and construction practices to be used are judged on four levels: Is there a potential health hazard to 1) the end user? 2) the installer? 3) the manufacturer? 4) the global environment?

The company is actively searching for non-toxic alternatives to conventional materials. Some examples they use are:

- **damproofing:** instead of bituminous coating, they use bentonite (a clay slurry).
- **roofing:** thatched roofs using Canadian straw
- **preserved wood:** naturally rot resistant wood from New Zealand
- **Insulation:** Aircrete, which is foamed-in-place magnesium oxide (R3.9 per inch), which sets to a brittle porous structure.

Mr. Bierman-Lytle's organization has set up a separate company (Environmental Outfitters) dedicated to making the best low tox products available to the building industry. Many of the products they sell are imported.

They do not test the unbuilt site for radon, but distribute drain tile under the basement slab. This gives the capacity to install sub slab depressurization if a radon problem is detected after construction. (The next edition of the National Building Code of Canada is going to call for this type of approach to radon control. Basements will have to be built on a bed of drain rock).

New Technology

There was relatively little new in the way of building products and practices. Foam panels, prefab trusses, shallow foundations and wet spray cellulose, while of general interest, were really not new to the aware designer or builder in Canada.

R-10+ windows (!?)

Perhaps the most interesting new product innovation was a presentation of work at the Solar Energy Research Institute (SERI) with evacuated windows and panels. (They have a vacuum chamber that can produce a 3'x3' sample).

Two sheets of glass or thin metal film separated by tiny glass beads are laser welded together after the space between the glass has been evacuated. The final product has an R value of 10. Metal panels can be as thin as 3 mm (1/8"). To improve the R-value, they are working on a triple glazed evacuated panel which has a selective coating and infrared reflective coating on the middle film, with glass beads on both sides.

The "perfect" glazing would also have an electrochromic film that would provide on-demand shading. (Like some prescription eye glasses that use this type of coating - they darken automatically as the light level gets brighter so sunglasses are not needed).

Further down they road is the development of a structural evacuated wall panel using a corrugated composite waferboard/fibre glass mesh product. Two panels, offset by one corrugation could give a 3½" thick module with structural cavities suitable for evacuation. Cost and technical feasibility on the job site are far from, clear at this time.

Direct Vent Gas Fireplace Update

In past issues we reported on a problem with some direct vent gas fireplaces.

The concern is explosive gas concentrations that could build up if there was delayed ignition if a spark does not light the gas instantly. When a spark is generated, conditions are ideal for an explosion, that can lead to the shattering of the glass front. This problem was not foreseen when the units were originally certified. As a result of problems, the Canadian Gas Association decertified *all* direct vent gas fireplaces pending additional tests. Units already installed will have to be modified in the field as required (depending on test results).

About 10% of all units sold (about 5,000 in B.C. alone) are direct vent, and are affected by this retesting.

The concern was strong enough that the B.C. Gas Safety branch went public, urging home owners to shut off the gas supply to their gas fireplaces, and not to use their units. Distributors are obliged to go back and do field modifications to those units that require them.

The CGA re-testing is being done quickly. Units meeting the new standards should have an "IR-40" sticker. At press time the following manufacturers have had their units tested and recertified:

Canadian Fireplaces: DV36 (N,P)
Clare: CF28 (N only)
Valor: 479, 480 & 502 CN only
Wolf Steel: GD3000 (N,P)
Gas Technologies: 6000 GDV 4000GDV (N, P)
Security Chimneys: 5GN36HAP & 5GP36HAP
Anglo-North American: Berryflame (Nat only)

Units not reinstated at press time include:
Wait, Selkirk, Faber, Myson, Superior, and **Hevac**

Vinyl flooring problems

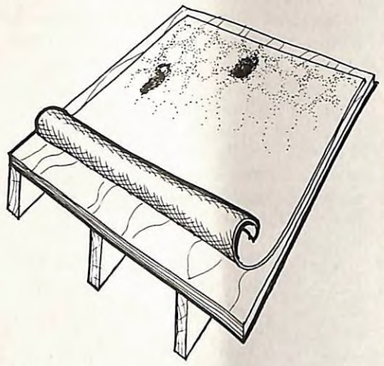
Richard Kadulski

I have recently encountered a problem with sheet vinyl flooring that was applied over a good one side plywood (with resin patches on the knots).

The use of GIS ply as a subfloor has become common in recent years as a way to overcome use of formaldehyde laced particleboards, and the potential water damage that particle board is subject to. The problem is that the vinyl flooring is discolouring in scattered patches, and the vinyl will have to be replaced.

The problem appeared within 6 months of installation. The lumber yard doesn't want to hear about the problem, but suggested to the builder that if they had known the plywood was to be used as a subfloor they would have recommended GIS ply with wood patches. (no such information is offered when the purchase is made).

The flooring distributor denied the possibility of product failure or faulty installations, but put the blame on the plywood. At the same time, without admitting blame, he offered help to replace the vinyl. The suggestion being made is that they know about this problem, that it's happened before, but



they don't want to say too much.

A representative of the Council of Forestry Industries of B.C. (COFI) has indicated they have encountered this situation before. The wood has not changed, but apparently some vinyl floor formulations and some synthetic resins have changed recently, without the knowledge of others. Part of the problem for the plywood industry is that there does not appear to be a consistent pattern of complaints. Some manufacturers have had complaints, others not, even though their products are similar.

COFI have done extensive testing and results are being analyzed. Plywood production is being monitored, and they are preparing new quality control programs. They have not prepared an advisory note yet. However, some manufacturers are producing a new smooth surface, all wood plywood subfloor.

Other flooring problems

There is evidence that floor discoloration and other subfloor related problems have happened with other materials. These include the warping of particleboard underlay.

In some cases it may be the result of changes to vinyl flooring products have changed affecting performance. One builder speculates that manufacturers may be downgrading their low-end products to promote more expensive products.

CHBA's Technical Research Committee is investigating this issue further. A survey is going to be done to determine just how how common, and what kinds of problems are encountered.

We, and CHBA - TRC would be interested in hearing of any problems you may have encountered.

If you have been fortunate enough not to have encountered any problems, be warned. In the short term, perhaps the safest solution is not to change products or suppliers unless you are comfortable with the new products.

Professional Builder: Is this you?

Two years ago *Harrowsmith* magazine commissioned me, along with two other architects to develop a modest 'affordable' home (about 1000 sq.ft.) that could be built for about $50,000. It was an interesting challenge.

Obviously the $50,000 budget figure is variable across the country, but the intent was for a house that could be built for a modest cost.

The response I received from readers suggests that given a good design that meets lifestyle and space requirements, there are many people out there that will settle for a modest home. Not everyone is trying to get into, or can afford large mansions. Some of the people that purchased

my plans are building the home as a cottage, as a retirement home, yet others as their first home.

I asked purchasers to let me know how their project went. As usually happens, the pressures of having the house built, moving and getting settled in have priority. Getting back to the architect from whom they purchased the plans via a magazine article is the last thing on their mind.

Recently I received a letter. The comments were very interesting, and should be of concern to every professional builder. A good reputation should be carefully cultivated. Word of mouth referral is the best form of advertising anyone can have (be he architect, builder, or merchant).

The following are extracts from the letter: (no names, but it took place in Eastern Ontario).

"We are delighted with the house ... it looks terrific... the living area is sunny and comfortable, the kitchen is great... and the bedrooms are bright and comfortable.....

"We had a contractor do the basement, framing and exterior finish, then we did the rest except for the drywall, which was subcontracted.... In general, everything went well, although we made a few changes (to the plans).....

"Our builder insisted on adding 2x4's on edge to the lower side of the roof joists to improve roof ventilation *(the design is a fully vaulted roof, 2x12 roof joists at a 1:1 pitch, to maximize upper floor space. If extra vent space was needed, it could have just as easily been added to the top of the joists. RK)*

"We didn't have time to fight about it at the time so we went along with it. It didn't seem to make much difference inside, but it means the ceilings upstairs are that much lower and there's not much space to spare to begin with. The builder reckoned his carpenters "enjoyed the challenge" of doing the roof framing! He also said that the plans were unusually complete; pity he didn't pay more attention to them.

"We didn't include a heat recovery ventilator *(as specified on the plans)* in the electric forced air heating system on the advice of our heating installer, but I think he may have been wrong. We did have a fresh air intake to the fan, and unless we run the fan constantly with the intake at least partly open we have high humidity in cold weather even when running the wood stove constantly. With the fan running it seems to be OK.

"Our biggest problem was that the builder ..... liked to do things his own way. He has a very high reputation locally and has been in business for many years, but not only did we have to fight to get what we wanted, we didn't always get it! For instance, your drawings specified 2'6" doors throughout, but when we came to install them we found he'd made the door openings to suit the framing, so we had a variety of sizes. Of course, at that point it would have just delayed matters further to get them changed."

The writer goes on with a few other points, about design changes they made. The complaints weren't only about the builder. ("the strange size of the bathroom meant we couldn't find a standard shower rail....non standard bathroom stuff may be available in Vancouver but it sure isn't here.)

We are in the customer service business. Before we dismiss the customer's ideas, we must be sure to distinguish technical issues from preferences.

Richard Kadulski

Is the window open or closed? Can you Tell?

Why open the window? Because you need fresh air, it's too hot, or you just want to hear the birds.

Why close it? It's become uncomfortable, the neighbour's cooking smells are floating in, your feet got cold, the wind started blowing papers around, or it's too noisy outside and you can't hear the birds! You might even have started to worry about the energy loss!

Comfort studies try to answer questions like: "When is fresh air needed, when is it too hot or too cold, when does air movement cause a problem?" Research work underway is trying to develop simplified models to predict the airflow through large openings. This should be able to answer questions such as: What is the air change rate and ventilation efficiency? How does the air temperature vary and its stratification develop over time? What is the heat flow when the window or door stays open for some time?

Figure 1 shows the typical air flow pattern and temperature stratification in a room with an initial air temperature of 20°C some time after turning on a baseboard heater. The temperatures and velocities are highest

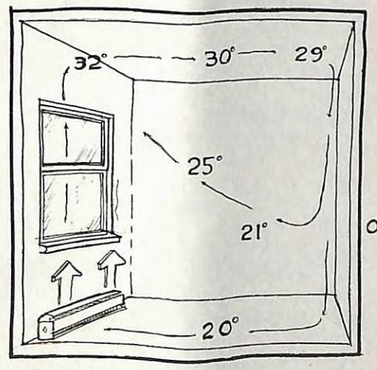


Fig. 1 heater turned on

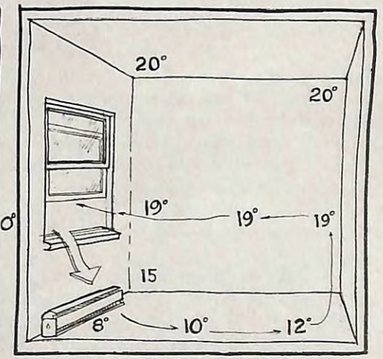


Fig. 2 winter condition, window opened

at the ceiling, while below the level of the heating equipment the temperatures remain virtually unchanged and the air velocities remain low until the floor warms up by the heat radiated from the ceiling.

A similar (but 'upside-down') flow pattern and temperature distribution is found in a room with initial air temperature of 20°C after the window is opened on a winter day. The lowest temperatures and highest air velocities are on the floor, while the temperature of the trapped warm air above the window remains unchanged until cooled by the heat radiated to the floor.

In both cases the time development of the vertical temperature gradient depends on the room geometry and the wall materials.

This work is part of the research on airflow patterns within building sponsored by the International Energy Agency.

Canadian Home Builders' Association

TRC News

The TRC has a full slate of technical issues that are being addressed by its standing subcommittees. For example, **ventilation and air quality, drywall discoloration** and emerging new problems with **flooring materials**. As well concerns are surfacing about imports of building products from the U.S. which may not meet Canadian standards. This could have adverse effects on our industry. The TRC is working with the Manufacturers' Council to investigate and report on this issue.

Sprinklers

The City of Vancouver recently enacted a bylaw that requires sprinklers be installed in **all** new housing, including single detached units. Council members apparently think they have taken a "progressive" step, which will be emulated by others across the country.

TRC has been instrumental in ensuring that appropriate research was conducted on this matter.

There are strong indications that Alberta is now heading in the direction of mandatory sprinklers in all housing.

Local and provincial associations across the country will need to become more aware of developments in their areas, and be prepared to take action.

TRC is planning to produce a "sprinkler kit" for local and provincial associations. This kit will summarize the most up-to-date information on cost effectiveness, technical and economic concerns. It will clearly set out CHBA's position, and will describe an action plan to enable the industry to keep on top of this issue.

Drywall Discoloration

Work is continuing to try and find the source of drywall discoloration problems. Some samples from Alberta were suspected to be bacterial or fungal growth. Agriculture Canada labs tried to grow some samples, but were unsuccessful. However, parallel testing at the NRC Biology Labs found indication of a growth.

Ventilation concerns

Ventilation concerns are prominent today, and many agencies are involved with research and regulatory issues. To avoid excessive duplication of effort, the TRC is establishing a **Ventilation Task Force** to review work and regulations in force or contemplated. The intent is to identify any gaps, conflicts or duplications.

HRV certification

With changes in the R-2000 Program administrative structure, a need for a heat recovery ventilator certification program became evident. A new North American HRV certification program is being established starting July 1990. It will be administered by the Heating and Ventilating Institute (HVI) in the US.

HVI is an industry organization that certifies that published manufacturer ratings are based on tests conforming to appropriate test standards.

HRV certification for R-2000 program approved equipment will come into force April 1, 1991. ORTECH will still be the principal laboratory to do HRV product testing.

How-To Ventilation Manual

In response to a need in Ontario for information on how to deal with ventilation, a how-to manual is being prepared. It is a joint venture between the Ontario New Home Warranty Program, Ontario Ministry of Housing and CMHC.

At the moment seven basic systems from the simplest to the most sophisticated will be reviewed. A supplement will provide more detailed information, dealing with such items as selecting grills and sizing. It will include a systems fact sheet and checklist.

A secondary objective of the project is to assess how closely designs that meet the 1990 NBC Ventilation requirements comply with the proposed standard CSA F326; and to identify what would be required for these ventilation designs to satisfy CSA F326 in its present form.

After completion of this version, the project will be expanded to be more appropriate in a national context.

National Survey of Lumber Moisture Content

Stud and framing lumber moisture contents will be sampled in over 600 houses under construction across Canada throughout 1990. The objective is to determine how common the use is of wet (above 19% moisture content) construction lumber. The survey will be complemented by questionnaire interviews with selected members of the building and lumber supply industries.

If you get a questionnaire, be sure to reply quickly.

Storm Water Runoff Control

It appears that basement flooding is a fairly common happening recently. A study is underway to try and identify the causes. It will also attempt to resolve current regulatory contradictions and to develop engineering solutions for improved handling of storm water runoff.

Walls Bowing

First it was truss uplift. Now it's wall bowing! A problem that has been occurring in areas of Saskatchewan is that exterior walls are bowing out over the course of a year. It is noticeable on kitchen walls as the bowing out is displayed by a gap that appears between the backsplash and the wall. This phenomenon is similar to truss uplift.

Crawl Space Ventilation Project

At the request of the B.C. Technical Advisory Committee, asking for assistance in clarifying the code requirements for crawl space ventilation, a field study (sponsored by CMHC) is underway. The project will take place this fall and winter. Ten houses will be tested for such items as moisture, pressure difference and temperature.

The results will provide recommendations on the building code requirements for crawlspace ventilation.

Radon

A report on Radon levels in Canadian houses will soon be available. The study (sponsored by CMHC) analyzed existing surveys and results from private testing laboratories to obtain an overall picture of radon levels. It suggests that average levels are higher than previously thought, and that there are more houses with radon levels above Canadian guidelines for remedial action.

Flooring problems

A number of reports about warping of particle board underlay have been received, especially in Alberta and Saskatchewan. It could be the result of product changes or some other reason.

A study in Saskatchewan is going to look at the extent of the problem.

Wood Span Tables

The Canadian Wood Council has prepared a new Imperial version of its span tables. This deals with the problem that voluntary metrication has not happened in the construction industry, while all codes and standards are written in metric. This leaves the situation open to serious error.

The new tables will also be available in pocket size, convenient for use on the job site.

Product Warranties

There have been reports that some vinyl siding manufacturers are voiding their warranties because the application was not applied over furring as instructed by the manufacturer. The TRC will investigate these reports and will advise builder members of the results.

This issue stresses the importance of using products correctly. When the producer provides installation instructions, they should be followed!

HOT 2000

WHAT IS IT?

HOT2000 is an advanced approach to the design and modelling of energy efficient structures.

HOT2000 is an easy-to-use computer program designed to assist builders, architects and engineers design low-rise residential buildings. Utilizing current heat loss/gain and system performance models, the program aids in the simulation and design of buildings for thermal effectiveness, passive solar heating and the operation and performance of heating and cooling systems.

WHAT CAN IT DO FOR ME?

HOT2000 lets you input comprehensive data on proposed building design, analyze the expected heat loss/gain, and revise and test altered designed until a satisfactory design is achieved.

Contains extensive weather data, several models for HRV, foundation, water heating systems, and more.

HOW TO GET HOT2000

HOT2000 is available from the Canadian Home Builders Association (CHBA) in either a Canadian or U.S. version at the following prices:

- $120.00 (Cdn) for the Canadian version
- $150.00 (US) for the USA Version (contains US weather data)
- Price includes User and Reference Manuals

To order HOT2000, complete the attached form and send it with a cheque or money order to:

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CHBA
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Ottawa, Ont. K2P 1L5
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IN COMING ISSUES:

Basement Technology A report that reviews basement construction practices and problems, and the advances that are being made in these technologies.

Fireplace Air Requirements A review of studies of five factory built fireplaces: do they work like they are really supposed to?

Windows: an update on developments in window technology.

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